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Volcanic ash identification and quantification with the new Raman and dual-polarization lidar R-Man510

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Volcanic aerosols in the atmosphere have a strong impact on human activities as shown by air traffic disruptions over Europe in April-May 2010 because of the threat for aircraft engines. Dispersion models have shown some limitations in the forecast of the spread and the concentrations of ash layers and must be validated against satellites and ground-based networks observations.

LiDARs active remote sensors are the only one capable of providing range-resolved measurements and thus determine the plume height. A network of operational aerosol profilers is required to evaluate atmospheric dispersion of the plume. Furthermore, theses profilers must be able to detect identify and possibly quantify the different structures/layers of aerosols and clouds from the lowest layers ($\sim$100 m) to the maximum flight levels (18 km).

R-Man$_{510}$ has been specially designed in order to address these needs. This sensor combines the full performances of sophisticated LiDARs (high accuracy and low overlap function) with the low maintenance requirements of cloud ceilometers (use of diode-pump laser for a low maintenance). The two elastic channels at 355 nm (co- and cross-polarization) give information on base and top of aerosol layers and particle shape (measurement of depolarization ratio). The nitrogen Raman detection at 387 nm is used for an accurate retrieval of extinction coefficient and lidar ratio (extinction-to-backscatter ratio). The coupling of depolarization ratio with lidar ratio gives a classification of aerosol and cloud layers and enables to discriminate volcanic ash layers from cirrus clouds or desert dust layers. Extinction coefficients can be converted into mass concentration profiles using optical-to-mass conversion factors determined with ancillary measurements (size distribution, complex refractive index and density). The overall uncertainty of this coupling is around 70% and is consistent with aviation authorities' requirements for marking out high risk fly and no-fly zones.

Some results of detection and classification of aerosol layers with the R-Man$_{510}$ lidar will be presented here.